

10-16-00

A

UTILITY PATENT APPLICATION TRANSMITTAL

(for Noncontinuing, Nonprovisional

Applications under 37 C.F.R. §1.53(b))

Attorney Docket No. 00-282  
68510 (6653)

jc915 U.S. PTO

09/687263

10/12/00

Box PATENT APPLICATION  
Commissioner for Patents  
Washington, D.C. 20231

Sir:

Transmitted herewith for filing  
under 37 C.F.R. §1.53(b) is the  
nonprovisional, noncontinuing  
patent application for:

Title: INSULATED BONDING WIRE  
FOR MICROELECTRONIC PACKAGING

First Named Inventor or  
Application Identifier:

Chok J. Chia

)  
) CERTIFICATE OF MAILING BY "EXPRESS MAIL"  
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) I hereby certify that this paper or fee is being  
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) Washington, D.C. 20231.  
) Pamela M. Stone  
) (Typed or printed name of person mailing)  
) Pamela M. Stone  
) (Signature of person mailing)  
)  
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- (x) 8 pages of the specification (including claims) are enclosed.
- (x) 1 page Abstract (page 9 of the specification).
- (x) 1 page cover sheet.
- (x) 4 sheet(s) of drawings are enclosed. ( ) Formal (X) Informal
- (x) An executed Oath or Declaration and Power of Attorney naming the actual inventors is enclosed.
- ( ) The names of persons believed to be the actual inventors are set forth in the enclosed unexecuted Oath or Declaration and Power of Attorney (§1.41(a) and §1.53(b)).
- (x) An Assignment(s) of the invention to LSI Logic Corporation, and Recordation Form cover sheet are enclosed.
- (X) A check in the amount of \$ 40.00 to cover the fee for recording the assignment(s) is enclosed.
- ( ) A 37 C.F.R. §3.73(b) Statement is enclosed (where an Assignee seeks to take action in a matter before the Patent Office).
- ( ) An Information Disclosure Statement is enclosed.

- ( ) A Form PTO-1449 is enclosed.
- ( ) \_\_\_\_\_ References (copies) listed on the Form PTO-1449 are enclosed.
- (X) A Return Receipt Postcard is enclosed (MPEP §503).
- ( ) Priority of application number \_\_\_\_/\_\_\_\_ filed on \_\_\_\_\_ in \_\_\_\_\_ is claimed under 35 U.S.C. §119.
- ( ) A certified copy of the priority document is enclosed.
- ( ) A MicroFiche Computer Program (Appendix) is enclosed.
- ( ) A Nucleotide and/or Amino Acid Sequence Submission is enclosed.
- ( ) A Computer Readable Copy is enclosed.
- ( ) A Paper Copy (Identical to Computer Copy) is enclosed.
- ( ) A Statement Verifying Identity of above Copies is enclosed.
- (X) The filing fee is calculated below:

Fee Calculation For Claims As Filed

(a) Basic Fee		\$ 710.00
(b) Independent Claims	<u>2</u> - 3 = <u>0</u> x \$ 80.00 = \$ <u>0</u>	
(c) Total Claims	<u>11</u> - 20 = <u>0</u> x \$ 18.00 = \$ <u>0</u>	
(d) Fee for Multiply Dependent Claims	\$270.00	\$ <u>0</u>
Total Filing Fee		\$ <u>710.00</u>

- ( ) A Statement(s) of Status as Small Entity is enclosed, reducing the Filing Fee by half to: \$ \_\_\_\_\_
- (X) A check in the amount of \$ 710.00 to cover the filing fee is enclosed.
- ( ) Charge \$ \_\_\_\_\_ to Deposit Account No. 06-1135.
- ( ) The payment of the Filing Fee is to be deferred until the Declaration is filed. Do not charge our Deposit Account.
- ( ) A separate written request under 37 C.F.R. §1.136(a)(3), which is a general authorization to treat any concurrent or future reply requiring a petition for an extension of time under 37 C.F.R. §1.136(a) for its timely submission as incorporating a petition for an extension of time for the appropriate length of time, is enclosed.

(X) The Commissioner is hereby authorized to charge any additional fees which may be required in this application under 37 C.F.R. §§1.16-1.17 during its entire pendency, or credit any overpayment, to Deposit Account No. 06-1135. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 06-1135. This sheet is filed in duplicate.

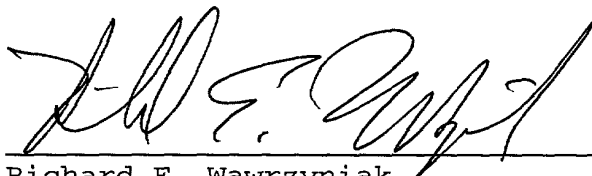
( ) Also enclosed:

(X) Address all future communications to:

LSI Logic Corporation  
1551 McCarthy Blvd., MS D-106  
Milpitas, CA 95035  
(408) 433-8000

10/12/00

(Date)



Richard E. Wawrzyniak  
Registration No. 36,048

# INSULATED BONDING WIRE FOR MICROELECTRONIC PACKAGING

Chok J. Chia  
Qwai H. Low  
Ramaswamy Ranganathan

**"Express Mail" Mailing Label Number**

Date of Deposit: October 12, 2000  
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Pamela M. Stone  
(Typed or printed names of person mailing)

Patricia M. Stone  
(Signature of person mailing)

**INSULATED BONDING WIRE FOR MICROELECTRONIC PACKAGING**

5

**BACKGROUND OF THE INVENTION**

The present invention relates generally to microelectronic packaging. More specifically, but without limitation thereto, the present invention relates to  
10 insulating bonding wires to avoid package defects resulting from short circuits between adjacent bonding wires.

Bonding wires are used in microelectronic packaging to connect bond pads of a chip or die to package  
15 leads. The bonding wires are typically made of gold or aluminum and have a thin diameter of only about 30 microns.

As chip size becomes smaller as a result of improvements in manufacturing and chip density, and as the  
20 size of the microelectronic package increases, the bonding wires have to be made longer and spaced more closely together. The increased length and closer spacing increases the probability that adjacent bonding wires will deviate from their intended position and come into  
25 electrical contact with one another, resulting in a defective package.

Another problem with current techniques for attaching bonding wires is that wires may not cross each other to avoid coming into electrical contact with one  
30 another and have to be attached in an array, one after another, restricting the versatility of the

microelectronic package.

#### SUMMARY OF THE INVENTION

The present invention advantageously addresses  
5 the needs above as well as other needs by providing a  
method and apparatus for insulating a bonding wire.

In one embodiment, the invention may be  
characterized as a method for insulating a bonding wire  
that includes the steps of attaching a bonding wire to a  
10 bond pad; coating the bonding wire with an insulating  
liquid while drawing the bonding wire through a bond tool  
from the bond pad to a package lead; and attaching the  
bonding wire to the package lead.

In another embodiment, the invention may be  
15 characterized as an apparatus for insulating a bonding  
wire that includes a dispensing tool coupled to a bond  
tool for forming a coating of an insulating liquid on a  
bonding wire after the bond tool attaches the bonding wire  
to a bond pad.

20 The features and advantages summarized above in  
addition to other aspects of the present invention will  
become more apparent from the description, presented in  
conjunction with the following drawings.

#### 25 BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects, features and  
advantages of the present invention will be more apparent  
from the following more specific description thereof,  
presented in conjunction with the following drawings  
30 wherein:

FIG. 1 is a magnified diagram illustrating a

dispensing tool for insulating a bonding wire according to an embodiment of the present invention;

FIG. 2 is a magnified diagram illustrating the dispensing tool of FIG. 1 moved to a coating position for  
5 applying an insulating liquid to the bonding wire;

FIG. 3 is a magnified diagram illustrating the dispensing tool of FIG. 1 coating the bonding wire;

FIG. 4 is a magnified diagram illustrating the dispensing tool of FIG. 1 after coating the bonding wire;  
10 and

FIG. 5 is a magnified diagram illustrating the attachment of the coated bonding wire of FIG. 4 to a package lead.

Corresponding reference characters indicate  
15 corresponding elements throughout the several views of the drawings.

#### DETAILED DESCRIPTION OF THE DRAWINGS

The following description is presented to  
20 disclose the currently known best mode for making and using the present invention. The scope of the invention is defined by the claims.

FIG. 1 is a magnified diagram illustrating a dispensing tool for insulating a bonding wire. Shown are  
25 a dispensing tool 102, a bond tool 104, a bonding wire 106, a die 107, a bond pad 108, a nozzle orifice 110, an insulating liquid 112, a microelectronic package 113, and a package lead 114.

The die 107 is mounted on the microelectronic  
30 package 113 according to standard techniques well known in the art. The microelectronic package 113 has a plurality

of package leads such as the package lead 114 that are connected by bonding wires to each bond pad 108. Current methods connect each bond pad 108 to each corresponding package lead 114 by an uninsulated bonding wire as

5 explained above. In contrast to these methods, the following embodiments of the present invention connect each bond pad 108 to each corresponding package lead 114 by an insulated bonding wire.

Still referring to FIG. 1, the dispensing tool  
10 102 has moved to a non-coating position away from the bond tool 104 to avoid mechanical interference while the bond tool 104 attaches the bonding wire 106 to the bond pad 108 according to standard techniques well known in the art.

The dispensing tool 102 includes the nozzle  
15 orifice 110 for dispensing the insulating liquid 112. Examples of the insulating liquid 112 are heat-cured epoxies and ultra-violet light-cured epoxies and polymers. The insulated liquid 112 may be pumped through the nozzle orifice 110 according to well known techniques for pumping  
20 liquids. In this example, the nozzle orifice 110 has a shape that is relatively narrow in the dimension parallel to the bonding wire 106 near the end of the bond tool 104 and relatively wide in the dimension perpendicular to the bonding wire 106. Typical dimensions for the nozzle  
25 orifice 110 are 100 microns in the dimension perpendicular to the bonding wire 106 and 50 microns in the dimension parallel to the bonding wire 106. The nozzle orifice 110 also has an arcuate shape that partially surrounds the bonding wire 106 in the coating position to apply a  
30 uniform thickness of the insulating liquid 112 to the bonding wire 106. Other shapes for the nozzle orifice 110



may be used to suit specific applications and materials used for the insulating liquid 112.

FIG. 2 is a magnified diagram illustrating the dispensing tool 102 moved to a coating position for  
5 applying the insulating liquid 112 to the bonding wire 106 after the bond tool 102 has begun drawing the bonding wire 106. In the coating position, the bonding wire 106 is partially surrounded by the nozzle orifice 110 of the dispensing tool 102 to apply a uniform thickness of the  
10 insulating liquid 112 to the bonding wire 106.

FIG. 3 is a magnified diagram illustrating the dispensing tool 102 coating the bonding wire 106. The insulating liquid 112 flows from the nozzle orifice 110 of the dispensing tool 102 around the bonding wire 106 as the  
15 bonding wire 106 is drawn through the bond tool 104 from the bond pad 108 toward the package lead 114. The dispensing tool 102 is coupled to the bond tool 104 so that the nozzle orifice 110 follows the end of the bonding wire 106 being drawn through the bond tool 104.

FIG. 4 is a magnified diagram illustrating the  
20 dispensing tool 102 after coating the bonding wire 106. When the bond tool 104 has drawn the bonding wire 106 from the bond pad 108 to the package lead 114, the flow of the insulating liquid 112 is stopped, and the dispenser tool  
25 102 moves to the non-coating position to avoid mechanical interference with the bond tool 104.

FIG. 5 is a magnified diagram illustrating the attachment of the coated bonding wire 106 to the package lead 114. The bond tool 104 terminates and attaches the  
30 bonding wire 106 to the package lead 114 according to standard techniques well known in the art. An energy

source 116 such as a heat gun or an ultraviolet light may be used to solidify the insulating liquid 112 coating the bonding wire 106. Alternatively, the insulating liquid 112 may be a self-curing material.

5 Additional bonding wires may be added and insulated in the same manner as the bonding wire 106 to complete the microelectronic package 113. Because each bonding wire 106 has been electrically insulated, bonding wires may cross over one another, have any desired length,  
10 and may be attached in any desired sequence without causing package defects. Insulating the bonding wires thus lowers the package cost, increases the pin density of the package, and improves the versatility of the package.

Other modifications, variations, and  
15 arrangements of the present invention may be made in accordance with the above teachings other than as specifically described to practice the invention within the spirit and scope defined by the following claims.

## CLAIMS

What is claimed is:

1. A method for insulating a bonding wire  
5 comprising the following steps:  
    (a) attaching a bonding wire to a bond pad; and  
    (b) coating the bonding wire with an insulating  
liquid while drawing the bonding wire through a bond tool  
from the bond pad to a package lead.

10

2. The method of claim 1 further comprising  
after step (b) the step of ceasing to coat the bonding  
wire with the insulating liquid.

15 3. The method of claim 1 further comprising  
after step (b) the step of attaching the bonding wire to  
the package lead.

20 4. The method of claim 1 further comprising  
after step (b) the step of solidifying the insulating  
liquid coating the bonding wire.

25 5. The method of claim 4 wherein the step of  
solidifying the insulating liquid comprises one of heating  
the bonding wire and exposing the bonding wire to  
ultraviolet radiation.

30 6. An apparatus for insulating a bonding wire  
comprising a dispensing tool coupled to a bond tool for  
forming a coating of an insulating liquid on a bonding  
wire after the bond tool attaches the bonding wire to a

bond pad.

7. The apparatus of claim 6 wherein the dispensing tool moves between a non-coating position for  
5 avoiding mechanical interference with the bond tool and a coating position for coating the bonding wire with the insulating liquid.

8. The apparatus of claim 6 wherein the  
10 dispensing tool has a nozzle orifice for dispensing the insulating liquid that is relatively narrow in a dimension parallel to the bonding wire and relatively wide in a dimension perpendicular to the bonding wire.

15 9. The apparatus of claim 8 wherein the nozzle orifice has an arcuate shape.

10. The apparatus of claim 6 further comprising an energy source coupled to the dispensing tool for  
20 solidifying the insulating liquid coating the bonding wire.

11. The apparatus of claim 10 wherein the energy source is one of a heat source and an ultraviolet  
25 light source.

# ABSTRACT

A method for insulating a bonding wire that includes the steps of attaching a bonding wire to a bond  
5 pad and coating the bonding wire with an insulating liquid while drawing the bonding wire through a bond tool from the bond pad to a package lead.

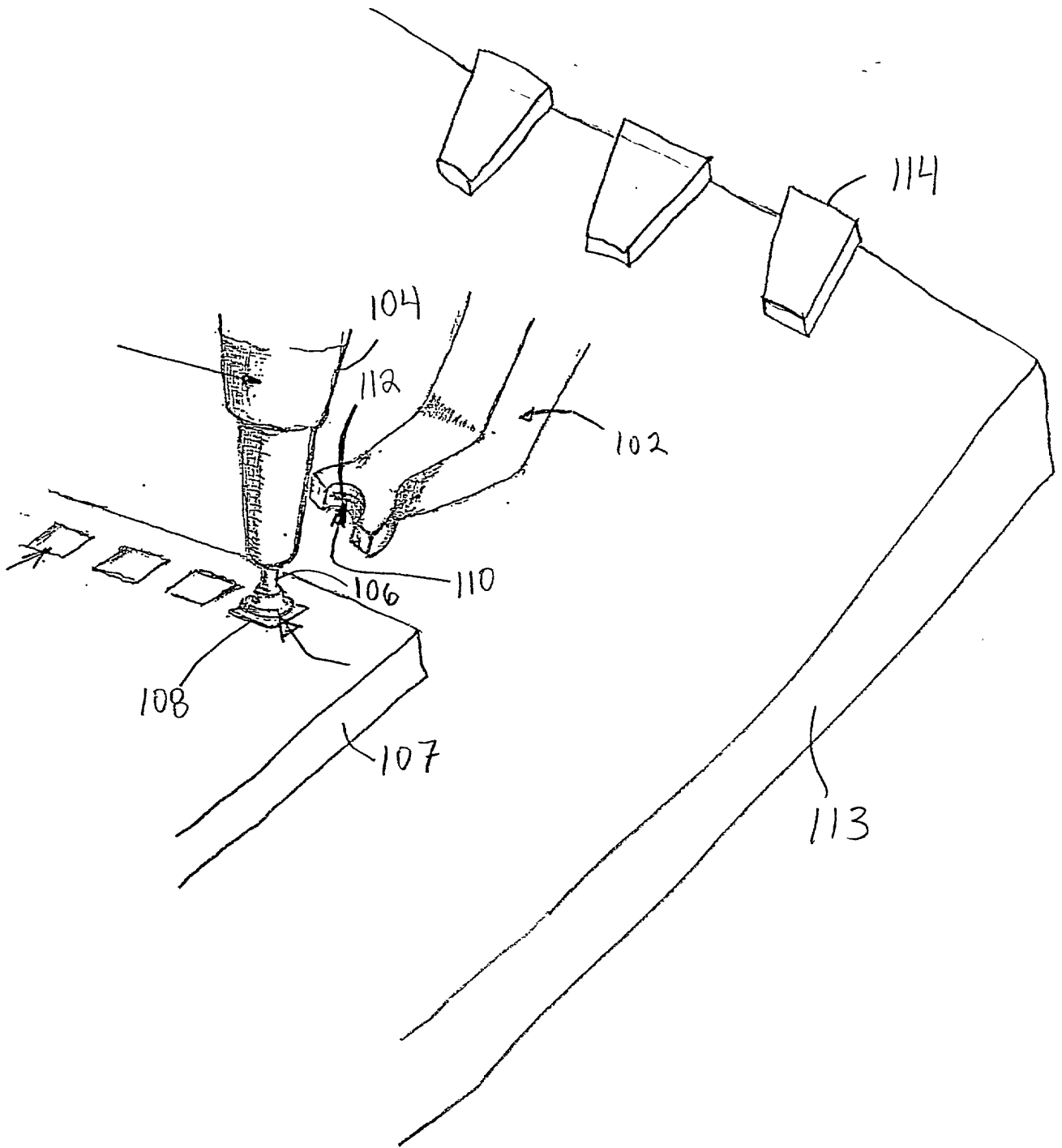


FIG. 1

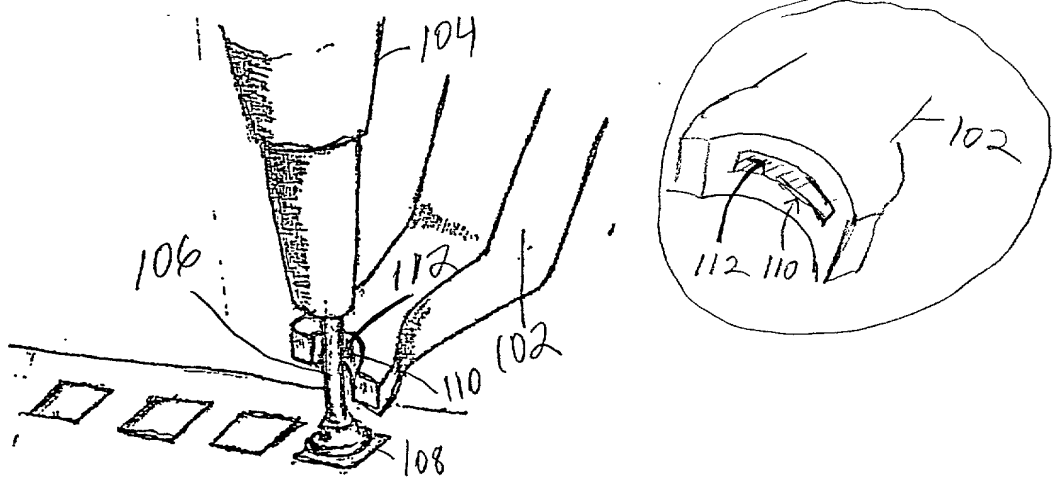


FIG. 2

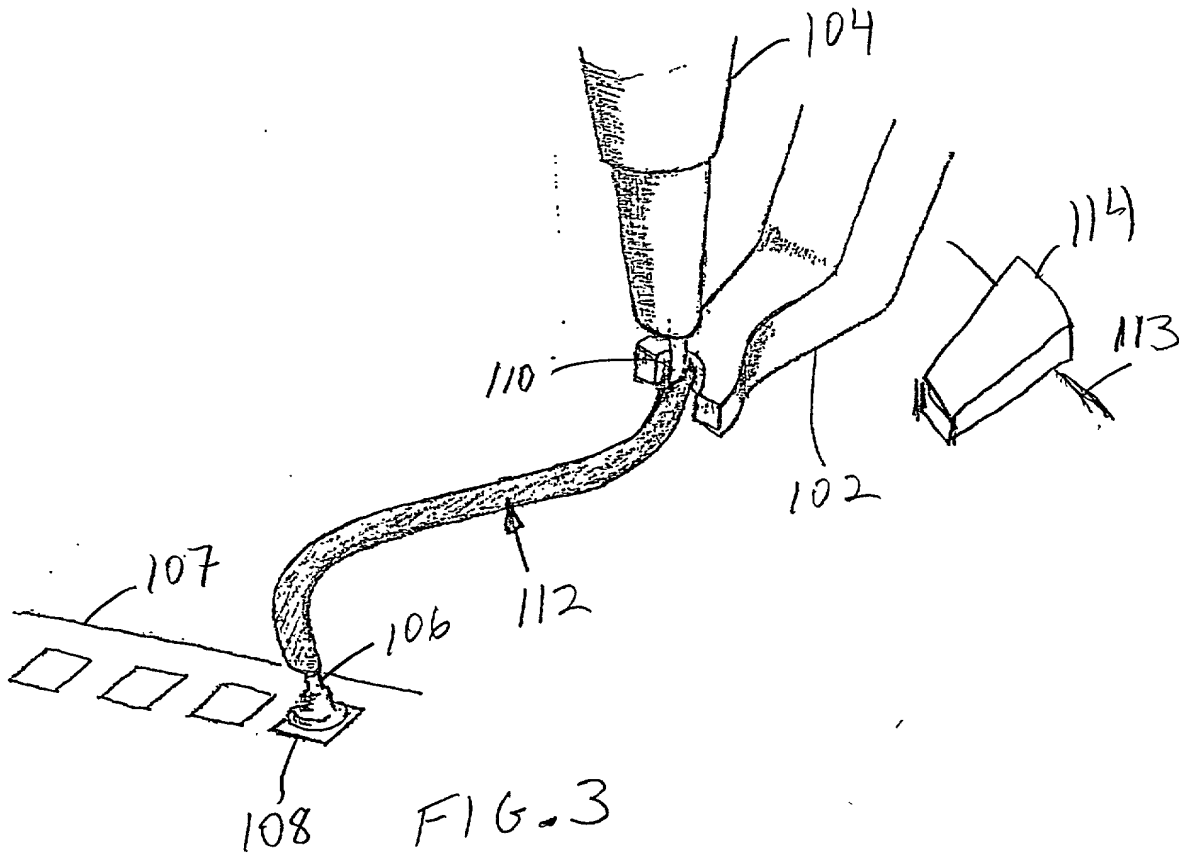


FIG. 3

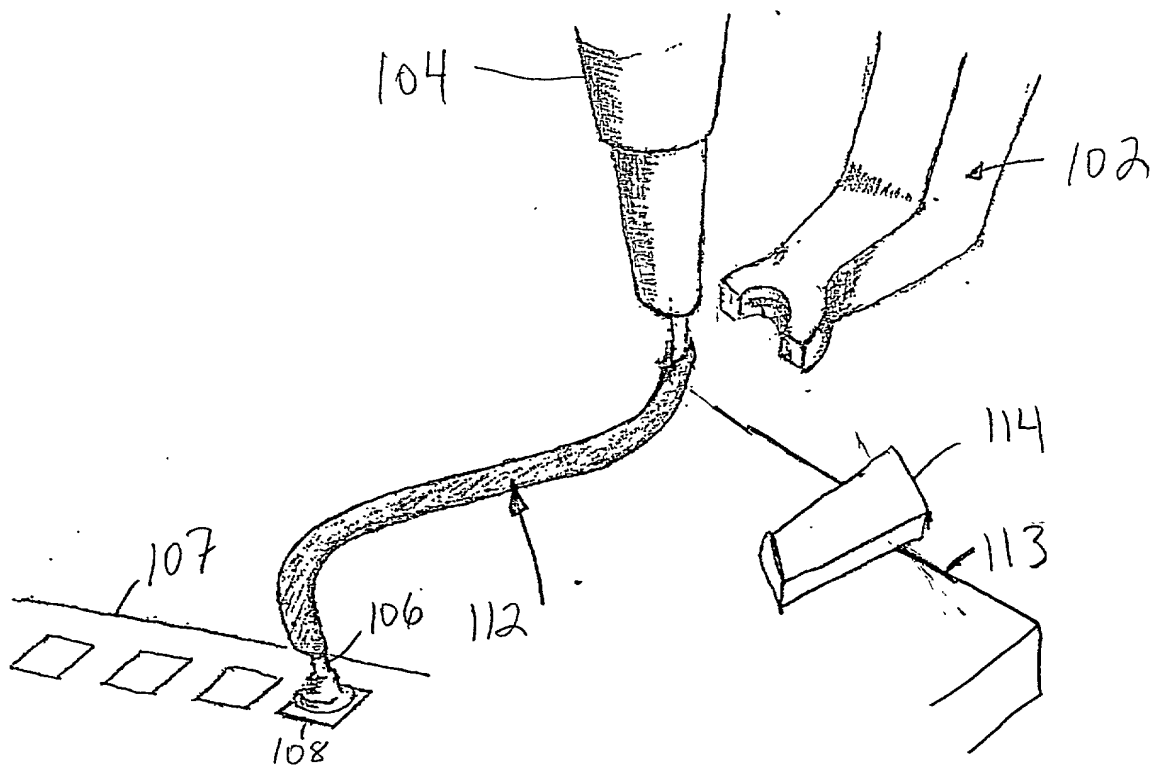
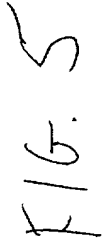
[illegible]

FIG. 4





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**DECLARATION  
FOR UTILITY OR DESIGN  
PATENT APPLICATION**

) Attorney Docket No.: DOCKET 00-282  
) (6653)68510  
)  
)  
) First Named Inventor: Chok J. Chia  
)  
) Application Number: TBD  
)  
) Filing Date: Herewith  
)  
) Group Art Unit: not yet known  
)  
) Examiner Name: not yet known

[x]Declaration    []Declaration  
Submitted       Submitted  
With            After  
Initial         Initial  
Filing          Filing

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

INSULATED BONDING WIRE FOR MICROELECTRONIC PACKAGING

the specification of which:

[X] is attached hereto, or

[] was filed by an authorized person on my behalf on \_\_\_\_\_  
(Date) as United States Application Number \_\_\_\_\_  
or PCT International Application Number \_\_\_\_\_,  
and was amended on \_\_\_\_\_ (if applicable).  
(Date)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application

which designated at least one country other than the United States of America, listed below, and I have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application, on this invention filed by me or my legal representatives or assigns and having a filing date before that of the application on which priority is claimed:

Prior Foreign Application Number(s)	Country	Foreign Filing Date	Priority Not Claimed	Certified Copy Attached	
				Yes	No

N/A

[ ] Additional foreign application numbers are listed on a supplemental priority data sheet attached hereto.

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below:

Provisional Application Number(s)	Provisional Application Filing Date
--------------------------------------	--

N/A

[ ] Additional provisional application numbers are listed on a supplemental priority data sheet attached hereto.

I hereby claim the benefit under Title 35, United States Code, §120, of any prior United States application(s), or under §365(c) of any PCT international application(s) designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose all information known by me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56, which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

Prior U.S. Application Number	Prior PCT International Application Number	Filing Date of U.S. or PCT International Application	Patent Number (if applicable)
----------------------------------	--	---	----------------------------------

N/A

[ ] Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet attached hereto.

As a named inventor, I hereby appoint the following registered practitioners, with full power of substitution and revocation, to prosecute

this application and to transact all business in the United States Patent and Trademark Office connected therewith, and request that all correspondence and telephone calls in respect to this application be directed to:

LSI Logic Corporation  
Corporate Legal Department  
Intellectual Property Services Group  
1551 McCarthy Blvd., M/S D-106  
Milpitas, CA 95035  
Telephone 408-433-8708; FAX 408-433-7770

and I hereby further appoint:

Ralph R. Veseli	33,807
Gary E. Ross	29,431
David G. Pursel	28,659
Sandeep Jaggi	43,331
Bruce R. Hoppenfeld	39,719
Lloyd E. Dakin	38,423

Whose address is: LSI LOGIC CORPORATION, 1551 McCarthy Blvd., Milpitas, CA 95035; Telephone No. (408) 433-8000

and I hereby further appoint:

<u>Registered</u> <u>Practitioner</u>	<u>Reg.No.</u>	<u>Registered</u> <u>Practitioner</u>	<u>Reg.No.</u>
Morgan L. Fitch, Jr.	17,023	Robert J. Fox	27,635
Francis A. Even	16,880	Kenneth H. Samples	25,747
Julius Tabin	16,754	Philip T. Petti	31,651
John F. Flannery	19,759	Bruce R. Mansfield	29,086
Robert B. Jones	20,135	Richard A. Kaba	30,562
James J. Schumann	20,856	Karl R. Fink	34,161
James J. Hamill	19,958	Thomas F. Lebens	38,221
Timothy E. Levstik	30,192	Richard E. Wawrzyniak	36,048
Joseph E. Shipley	31,137	Scott J. Menghini	42,880

I hereby declare that all statements made herein of my own knowledge are true, and that all statements made herein on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity or enforceability of the application or any patent issued thereon.

Full name of sole or one  
joint inventor:

Chok J. Chia

(Given names first, with Family name last)

Inventor's signature:

Date:

Oct 10, 2000

Residence:

10132 Prado Vista Dr., Cupertino, CA 95014  
(City and State for U.S. Residents;  
City and Country for others)

Post Office Address:

10132 Prado Vista Dr., Cupertino, CA 95014

Citizenship:

Malaysia

Full name of sole or one  
joint inventor:

Owai H. Low

(Given names first, with Family name last)

Inventor's signature:

Date:

Oct. 10, 2000

Residence:

10225 East Estate Dr., Cupertino, CA 95014  
(City and State for U.S. Residents;  
City and Country for others)

Post Office Address:

10225 East Estate Dr., Cupertino, CA 95014

Citizenship:

Malaysia

Full name of sole or one  
joint inventor:

Ramaswamy Ranganathan

(Given names first, with Family name last)

Inventor's signature:

Date:

Oct 10, 2000

Residence:

14711 Vickery Place, Saratoga, CA 95070  
(City and State for U.S. Residents;  
City and Country for others)

Post Office Address:

14711 Vickery Place, Saratoga, CA 95070

Citizenship:

US